PB-250 539

ALCOHOL AND HIGHWAY SAFETY

NATO Committee on the Challenges of Modern Society

Prepared for:

National Highway Traffic Safety Administration

1969

DISTRIBUTED BY:

NTIS

National Technical Information Service
U. S. DEPARTMENT OF COMMERCE

BIBLIOGRAPHIC DATA SHEET	1. Report No.	2.	3. Recipient's Accession No. PB250539
4. Title and Subtitle Alcohol and Highway Safety A Review in Quest of Remedies			5. Report Date 6.
7. Author(s)			8. Performing Organization Rept. No. 28
9. Performing Organization Name and Address Committee on the Challenges of Modern Society NATO			10. Project/Task/Work Unit No. 11. Contract/Grant No.
12. Sponsoring Organization Name and Address Road and Motor Vehicle Traffic Safety Ministry of Transport Canada			13. Type of Report & Period Covered 14.

15. Supplementary Notes

16. Abstracts

Alcohol is one of the major causes of traffic accidents in all industrialized countries. The rate of these accidents varies in different countries and requires individual testing and solutions.

17. Key Words and Document Analysis. 17a. Descriptors

Alcohol and highway safety

17b. Identifiers/Open-Ended Terms

17c. COSATI Field/Group

PRICES SUBJECT TO CHANGE

18. Availability Statement	19. Security Class (This Report) UNCLASSIFIED	21. No. of Pages 64
1<	20. Security Class (This Page) UNCLASSIFIED	22. Price *4.50

FORM NTIS-35 (REV. 10-73) ENDORSED BY ANSI AND UNESCO. THIS FORM MAY BE REPRODUCED USCOMM-DC 8265-P74

PB 250 539

ALCOHOL AND HIGHWAY SAFETY

COMMITTEE ON THE CHALLENGES OF MODERN SOCIETY

ROAD SAFETY PILOT STUDY

L'ALCOOL ET LA SÉCURITÉ ROUTIÈRE

COMITÉ SUR LES DÉFIS DE LA SOCIÉTÉ MODERNE

L'ÉTUDE PILOTE SUR LA SÉCURITÉ ROUTIÈRE

REPRODUCED BY
NATIONAL TECHNICAL
INFORMATION SERVICE
U. S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA. 22161

079009

alcohol and highway safety.

A Review in Quest of Remedies

2<

PART I

ALCOHOL AND HIGHWAY SAFETY:

Report on the NATO/CCMS Study

Road and Motor Vehicle Traffic Safety
Ministry of Transport
Canada

TABLE OF CONTENTS

	Page
Introduction.....	1
The Problem.....	3
The Study.....	4
The Findings.....	6
Conclusions and Recommendations.....	7

Introduction

On April 10, 1969 - less than four months after taking office - President Nixon called for NATO to take action on environmental problems, declaring

> ". . . (NATO) needs a social dimension, to deal with our concern for the quality of life in this final third of the twentieth century . . . the industrial nations share no challenge more urgent than that of bringing 20th century man and his environment to terms with one another . . ."

In November 1969, NATO accepted the President's proposal, established the Committee on the Challenges of Modern Society - CCMS - and directed it to improve in every practical way the exchange of views and experience among the allied countries in the task of creating a better environment for their societies, and to consider specific problems with the deliberate objective of stimulating action by member governments.

To carry out its mandate, CCMS has developed a novel approach under which one NATO member as "Pilot" assumes the responsibility to undertake and complete a program. With one-nation leadership, programs move ahead quicker than under the working committee approach which is characteristic of most international efforts. Also, the need for an international secretariat is substantially reduced.

Road Safety Pilot Study

At the first CCMS meeting in late Fall 1969, the U. S. Representative to CCMS proposed all aspects of road safety - vehicle, highway, driver - as a CCMS effort which the U. S. would lead. NATO accepted. The National Highway Traffic Safety Administration of the Department of Transportation conducted the Study for the U. S.

The Road Safety Pilot Study was divided into seven projects, each led by a NATO ally: Motor Vehicle Inspection - Federal Republic of Germany; Emergency Medical Services - Italy; Alcohol and Highway Safety - Canada; Pedestrian Safety - Belgium; Accident Investigation Netherlands; Identification and Correction of Road Hazards - France; and Experimental Safety Vehicle - United States. Each of these efforts was a self-contained project in its own right and apart from overall coordination by the U. S. as Pilot Country has been directed by the NATO country indicated. The other allies have participated in those projects of major interest to them and such participation is noted in the final report for each of the seven projects. The conclusions and

recommendations contained in these project reports are in turn discussed in the overall Pilot Study report.

The basic purpose of CCMS is to stimulate government action - not research per se. While more research is needed in all aspects of road safety, the CCMS premise is that much is already known in one country which other countries might utilize or adapt to their unique problems. Thus, an overriding goal of all the road safety projects has been to organize the extant knowledge on road safety programs of proven effectiveness in a manner that will facilitate putting these programs into practice where they are not now in operation.

The Problem

It has long been recognized that alcohol adversely affects the ability to perform a complex task. This problem becomes much more serious when the task is operating a motor vehicle in the traffic milieu since it involves other individuals who have not consumed alcohol.

Alcohol is one of the major causes of traffic accidents in all industrialized countries. To have control of a motor vehicle, or to be a pedestrian while impaired by alcohol, greatly increases the likelihood of being involved in an accident. In North America it appears that, in over 50 per cent of all accidents in which a fatality occurs, the driver of the automobile had been drinking prior to the accident. This alcohol involvement rate varies from country to country and it is estimated that it may be as low as 10 per cent in some countries.

There is strong evidence from existing studies that, while problem drinkers and alcoholics make up a small portion of the total population, they account for a very considerable part of the overall problem of traffic fatalities. Drivers involved in this type of accident are frequently known to alcoholism clinics and their driving records often show previous convictions for impaired driving.

In Canada studies have indicated that 50 per cent of all fatally injured drivers had been drinking shortly before their death. 78 per cent of these drivers had blood alcohol contents of .10% by weight or greater. A roadside survey conducted by the Federal Government found that, during evening hours, one in five drivers had been drinking and one in twenty was impaired. In view of this, there have been many attempts to institute measures that will reduce the incidence of drinking and driving; however, none of these have proved to be dramatically successful. In 1969 the Federal Government enacted legislation making it illegal to have control of a motor vehicle if the blood alcohol content is greater than 80mg of alcohol per 100ml of blood. This restriction was new in that it established a definite level above which it was illegal to have control of a motor vehicle; however, there has been legislation in Canada for many years making it illegal to operate a vehicle while impaired by alcohol. In some provinces there is legislation allowing police to suspend a driver's licence for 24 hours if it is suspected that he is impaired. The Canada Safety Council and many provincial organizations have conducted vigorous public education campaigns warning the public of the dangers of combining drinking and driving.

The Study

The Canadian Ministry of Transport recognizing the important relationship between alcohol and driving has performed a number of studies designed to identify countermeasures to this problem. Therefore, the Ministry was pleased to accept the leadership for the Alcohol and Highway Safety portion of the NATO/CCMS Pilot Study on Road Safety. The Canadian project consisted of the following steps and projects:

- A personal visit by a Canadian researcher to several member countries to discuss the problem with other leading researchers;

- The preparation and circulation of a questionnaire on alcohol and driving including a detailed review of 25 countermeasures. The following 28 countries responded to the questionnaire:

Australia	France	Japan	Romania
Austria	Germany	Malaysia	South Africa
Belgium	Great Britain	Netherlands	Spain
Canada	Hungary	New Zealand	Sweden
Czechoslovakia	Iceland	Norway	Switzerland
Denmark	India	Poland	Turkey
Ethiopia	Republic of Ireland	Portugal	United States

- The analysis and collation of the 28 replies;

- A series of pilot studies for the purpose of developing roadside survey techniques;

- The development of a protocol for roadside surveys with the co-operation of the following NATO countries: The United Kingdom, France, United States, Netherlands, Denmark, Italy, West Germany, Belgium, and the OECD;

- Four projects to evaluate existing Canadian countermeasures:

  1) The Edmonton Study - October, 1973,

  2) The Breathalizer Legislation - An Inferential Evaluation - October, 1973;

3) The Evaluation of the Alberta Impaired Drivers Project (a rehabilitation program) - not yet published;

4) The Evaluation of a Drinking/Driving Public Education Campaign in Saskatchewan - not yet published.

- Two reports have been prepared:

  a) Alcohol and Traffic Accidents: A review in Quest of Remedies;

  b) Roadside Surveys of Drinking-Driving Behaviour: A Review of the Literature and a Recommended Methodology

- Supporting documentation containing the results of the questionnaire survey, and a catalogue of breath testing devices have been compiled.

9-

The Findings

Most countries have taken steps to disuade people from driving after having consumed alcoholic beverages. The two most common countermeasures used are legal restrictions on the use of vehicles after consuming alcohol and public education designed to discourage driving after drinking. Although these two countermeasures are common to many countries the method of their implementation varies widely. The legal level of BAC above which the individual is considered to be in control of a vehicle illegally varies from .05% by weight to .15% by weight and in some countries two standards are used corresponding to the degree of seriousness of the offence. The penalties resulting from conviction also vary greatly from one country to another.

Education Countermeasures have been used to rehabilitate drivers convicted of alcohol/driving offences, to alert road users to the hazards of drinking and driving, and to prepare the public to accept tougher drinking/driving laws. With these and other countermeasures the lack of data on their effectiveness is striking. There is little or no knowledge of the effect of individual countermeasures on reducing the incidence of drinking and driving, on the reduction of alcohol involvement in serious accidents or their overall impact on the road safety problem. It is apparent that countermeasures are being implemented on speculation and ideology rather than solid evidence of their effectiveness. The use of periodic roadside surveys will provide a method of monitoring the drinking/driving problem and will provide the information needed to make meaningful evaluation of countermeasures possible.

It is evident that, since drinking and driving is tied closely to the drinking habits in a country and society's general attitudes to drinking, countermeasures must vary from country to country and be designed with the individual country's legal and social norms in mind.

For these reasons it is not possible to recommend in detail programs of action that will be equally effective in all countries. However, it is possible to indicate countermeasure opportunities that all countries should examine and adapt to their specific needs. This has been done in the report "Alcohol and Traffic Accidents: A Review in Quest of Remedies".

CONCLUSIONS AND RECOMMENDATIONS:

Conclusion: To assess the extent of the impaired driving problem and to provide a data base against which to evaluate future countermeasures, it is highly desirable to perform a national roadside screening survey of breath alcohol in all drivers at a selected sample of points in a road network.

Recommendation: Each member nation initiate a roadside screening study within the next year.

Next Step: This recommendation be an annex to the International Road Safety Resolution.

Conclusion: In order to compare the impaired driving problem and the effectiveness of countermeasures used in several nations, it is essential that similar protocols for roadside screening surveys be used by all countries.

Recommendation: That protocols, developed in co-operation with the Organization for Economic Co-operation and Development and presented in Roadside Surveys of Drinking/Driving Behaviour, be adopted by all countries as the standard method for conducting roadside surveys, and the resulting data be exchanged.

Next Step: This recommendation be an annex to the International Road Safety Resolution.

Conclusion: In order to ensure the continuing exchange of information on the problem of drinking and driving and the effectiveness of countermeasures, each nation must undertake to scientifically evaluate new countermeasures and designate a contact responsible for information exchange. A systematic program of exchange must be established.

Recommendation:	Each country will agree to evaluate new drinking-driving countermeasures, to exchange information on drinking and driving, and to appoint a technical contact who will be responsible for seeing that all such information is sent to member countries and that all roadside survey data is sent to a volunteer country for co-ordination. In turn this country will collate, analyze and disseminate the results of these studies.
Next Step:	This recommendation to be an annex to the International Road Safety Resolution.

12

PART II

ALCOHOL AND HIGHWAY SAFETY

ALCOHOL AND TRAFFIC ACCIDENTS:

A Review in Quest of Remedies.

Road and Motor Vehicle Traffic Safety
Ministry of Transport
Canada

ACKNOWLEDGEMENTS

G.J.S. Wilde, Ph.D., Professor of Psychology, Queen's University, Kingston, Ontario, Canada, prepared this report as a consultant to the Canadian Ministry of Transport with the assistance of the Staff of the Road and Motor Vehicle Traffic Safety Branch - S.C. Wilson, Assistant Director, Countermeasures Development, Carl M. Stroh, Ph.D., Chief, Human Systems.

The assistance and co-operation of the representatives of the other govenrnments participating in the NATO/CCMS Pilot Study on Road Safety and the countries who responded to the International Questionnaire and in particular the helpful comments provided by Robert B. Voas, Ph.D., Chief, Evaluation Division, Office of Alcohol Countermeasures of the United States Department of Transportation and Robert F. Borkenstein, Professor, Department of Forensic Studies, Indiana University, Bloomington, Indiana, are gratefully acknowledged.

CONTENTS

Page

1. Drinking and Driving: The Problem..... 1

2. Characteristics of Those who Drive After Drinking..... 4

3. Alcohol in the Human Body..... 6

4. BAC and Behavioural Impairment..... 8

5. The Involvement of Alcohol in Accidents and in Behaviour Related to Safety..... 10

6. Legal Restrictions and Penal Consequences..... 12
   - 6.1 Driving while under the influence of Alcohol..... 12
   - 6.2 Other legal measures..... 14

7. Deterrent Effects of the Law..... 16
   - 7.1 Special deterrence..... 16
   - 7.1.1 Licence suspension..... 16
   - 7.1.2 Jail terms..... 16
   - 7.1.3 Fines..... 17
   - 7.2 Other consequences of penal action..... 17
   - 7.3 General deterrence..... 18

8. Detection of Intoxicated Driving and Measurement of BAC..... 20

9. Educational Countermeasures..... 23

10. Miscellaneous Countermeasures..... 25

11. Evaluating Countermeasure Effectiveness..... 27

12. Conclusions and Recommendations..... 29
   - 12.1 Legal BAC limits..... 31
   - 12.2 Increasing subjective apprehension risk..... 32
   - 12.3 Improving the legal process..... 32
   - 12.4 Accessories to the offence..... 33
   - 12.5 Special traffic courts..... 33
   - 12.6 Expanding research efforts..... 33
   - 12.7 Public education..... 34
   - 12.8 The responsibility of the news media..... 34
   - 12.9 Reward versus punishment..... 34

Notes..... 36

1. Drinking and Driving: The Problem

From many countries in the world come reports attesting to the frequent presence of alcohol in drivers involved in accidents. The relevant rates differ widely from country to country as reflected in the fact that critically high alcohol levels are found in less than ten per cent of fatal accidents in some countries and in well over fifty per cent in other places. General, though not universal, is the observation that high levels of blood alcohol are about twice as frequent in fatal accidents as in accidents resulting in physical injuries. Thus, the more serious the crash, the higher the involvement rate of alcohol. Car passengers are frequently found to be as much under the influence of alcohol as the accident involved driver. Those fatally injured drivers who are not considered legally at fault as regards the causation of the accident, also show to have been drinking much more than the general population at risk. This suggests that these drivers are less able to avoid accidents provoked by driving errors and violations made by others (1).

Pedestrians involved in fatal accidents constitute no exception in this respect. Their levels of blood alcohol are of the same order of magnitude as those of accident involved drivers (2).

The enormity of the problem in industrialised countries poses a considerable challenge to the development of legal, educational, and other countermeasures as well as to research into the effects of alcohol upon the human organism and into the actual effects of existing measures aimed at the reduction of driving after drinking.

The Canadian Ministry of Transport, recognizing the serious implications of the presence of alcohol in traffic, has made a number of studies designed to identify countermeasures against this problem. Therefore, the Ministry was pleased to accept the leadership for the Alcohol and Highway Safety portion of the NATO/CCMS Pilot Study on Road Safety. The Canadian project consisted of the following steps and projects:

- A personal visit by a Canadian researcher to several member countries to discuss the problem with other leading researchers;

- The preparation and circulation of a questionnaire on alcohol and driving including a detailed review of 25 different countermeasures. The following 28 countries responded to the questionnaire:

Australia	France	Japan	Romania
Austria	Germany	Malaysia	South Africa
Belgium	GreatBritain	Netherlands	Spain
Canada	Hungary	New Zealand	Sweden
Czechoslovakia	Iceland	Norway	Switzerland
Denmark	India	Poland	Turkey
Ethiopia	Republic of Ireland	Portugal	United States

- The analysis and collation of the 28 replies;
- A series of pilot studies for the purpose of developing roadside survey techniques;
- The development of a protocol for roadside surveys with the co-operation of the following NATO countries; the United Kingdom, France, the United States, the Netherlands, Denmark, Italy, West Germany, and Belgium, as well as with the Road Research Program of the OECD;
- Four projects to evaluate existing Canadian countermeasures:
  1) The Edmonton Study - October 1973;
  2) The Breathalizer Legislation - An Inferential Evaluation - October, 1973;
  3) The evaluation of the Alberta Impaired Drivers Project (a rehabilitation program) - not yeat published;
  4) The Evaluation of a Drinking/Driving Public Education Campaign in Saskatchewan - not yet published.
- Two reports have been prepared:
  a) Alcohol and Traffic Accidents: A Review in Quest of Remedies;
  b) Roadside Surveys of Drinking/Driving Behaviour: A Review of the Literature and a Recommended Methodology.
- Supporting documentation containng the results of the questionnaire survey, and a catalogue of available breath testing devices have been compiled.

It is the purpose of the present report to present a summary of the activities in these areas and the results obtained. The relevant information was largely derived from two sources (a) the questionnaire investigation of the drinking/driving countermeasures activities in twenty-eight countries, and (b) selected references from the scientific literature.

On he basis of the synoptic account of the present state of knowledge, a number of conclusions has been drawn and recommendations for future action have been formulated.

2. Characteristics of Those Who Drive After Drinking

On the basis of the frequency and amount of driving, a distinction is often made between four categories of individuals:

(a) Persons who do not consume alcoholic beverages at all;
(b) Social or moderate drinkers, those who drink at social events (e.g. parties, receptions, in the family circle) and in conjunction with the intake of food;
(c) Problem drinkers, those whose drinking may be viewed as an attempt to cope with life stress, but whose drinking behaviour frequently produces additional (marital, occupational, etc.) problems, and
(d) Alcoholics, whose excessive drinking and dependence upon alcohol has attained such a degree that interference with mental and physical health, interpersonal relations, and smooth social economic functioning is in evidence (3).

Despite the lack of quantitative precision of the boundaries between the categories described, there is good reason to believe that while problem drinkers and alcoholics constitute but a small minority of the total population, they account for a very considerable part of the overall problem of traffic fatalities, injuries, and violations. The blood-alcohol levels ascertained in such events are often of a level reached only rarely by moderate drinkers. The drivers involved are frequently known to clinics for alcoholism and related social agencies and their driver records often show earlier convictions for driving while impaired (4). In fact, in one country, it is estimated that about two-thirds of all alcohol-involved accidents are incurred by problem-drinkers and alcoholics, who, as a group, are believed to be responsible for one-third of all traffic fatalities in that country, although they constitute only about four per cent of the entire population (5, 6). Due to variations in drinking patterns, automobile driving and their combinations, these estimates may well be very different in other areas of the world (7, 8, 9, 10).

However, high levels of blood alcohol are not the only distinguishing feature of these individuals. They are also predominantly male. The highest levels of blood alcohol are frequently found not in the very young, nor in the older drivers, but in persons between the mid-twenties to the mid-fifties (11, 12). Those drivers who are divorced, separated, or have relatively low levels of education are also more likely to drive after drinking. Personality studies of individuals apprehended for driving after heavy drinking have pointed at the high incidence of paranoid ideation, self-destructiveness, suicidal tendencies, hostility, obsessional rumination (11), manual occupation, criminal records (12), neuroticism, extraversion, social immaturity, and willingness to accept risks (13).

It is interesting to note that a greater willingness to engage in risky behaviour was also found when these same individuals were sober. Other investigators have found evidence that alcoholics also have more accidents than the general population even when they have not been drinking (14), although they have many fewer accidents than when they have been drinking. This consideration, in conjunction with the prevalence of the above mentioned traits of personality, might make it questionable to assume that an alcoholic in a state of sobriety is no more than an average traffic risk. Alcohol does not "cause" accidents in the same way as heat causes ice to melt. Some individuals may be poor drivers for the same reason that they drink too much. The intake of alcohol further exacerbates their unfitness to drive. They seem to accept the risks associated with heavy drinking, and if sober they may be willing to engage in other behaviour that increases the likelihood of an accident.

Individuals with a high-blood alcohol concentration or BAC level, including alcoholics and problem drinkers, are known to have a disproportionate number of fatal and physically injurious accidents not only while they are driving, but also when they make use of the roads as pedestrians or even in non-traffic situations (15, 16, 17, 18, 19, 20). In one study it was found that less than one-tenth of all alcoholics who died in accidents in the course of a particular year did so as automobile drivers (16). This does not necessarily suggest that driving a car is a relatively safe activity for an alcoholic, but it does mean that preventing alcoholics from driving, while not preventing them from drinking, will conceivably not be followed by a commensurate reduction in mortality due to all types of accidents, although a favourable change in mortality statistics of traffic alone might ensue.

It is often stated that driving while intoxicated is more typical for problem drinkers and alcoholics in the relatively early stages of their illness than for the advanced and clinical stages. This is why detection of driving after heavy drinking may be utilised as a means of identifying incipient alcoholics and as a basis for referral to appropriate treatment. Such practice might be of considerable preventative benefit to the individuals involved, and it might also help to foster a general attitude among the public at large that driving after heavy drinking is not 'masculine, bold, and daring', but is 'sick' behaviour indeed (21).

3. Alcohol in the Human Body

Of all absorbed (through stomach and small intestines) beverage alcohol (ethanol) ingested by the human body, about 95% is oxidised, and the remainder is eliminated through expired air, perspiration, urine and saliva. Hence the possibility of obtaining estimates of the invividual's blood-alcohol concentration (BAC) by a variety of means in addition to blood tests. Alcohol concentrations are usually expressed in terms of milligrams ethanol per 100 millilitres of fluid. Thus a BAC equalling 50 refers to 50 milligrams of ethanol per 100 millilitres of blood. Common notation in this case is BAC 50 mg/100 ml.

Alternatively, BAC is sometimes expressed as the percentage of ethanol by weight of the fluid or tissue sampled by weight, leading to a notation such as BAC .05% by wt. As the specific gravity of blood is approximately 1.05 (5% heavier than water), there is (apart from the decimal point) a slight discrepancy between the numerical values of the two notation systems, amounting to about 5% of the reading. A BAC 50 mg/100 ml would thus correspond to a BAC .0476% by wt.

Regardless of notation used, there may be considerable differences, amounting to approximately 50 per cent of the obtained values, depending upon the type of blood sampled arterial, venous, and capillary). But these differences decrease as the time lapse between ingestion of alcohol and blood testing increases (22).

Other factors that may influence quantitative measurements are presence of ketones (as in diabetics), aldehydes and post mortem formation of alcohol. The assumption of a constant ratio between blood and urine alcohol concentration has also met with criticism (22) as well as the practice of estimating BAC levels from breath samples. Among the prominent factors of distortion have been mentioned: the mixture of deep-lung (alveolar) and bronchial air produced by the individual, outside air temperature, belching, hyperventilation, presence of alcohol in the mouth, and duration of blowing. Although some of these difficulties may be obviated, toxicologists and related experts insist upon the limitations of available technical procedures and they advocate the use of conservative estimates of BAC if they are to be used as legal evidence (23). They also warn against the practice of retrospective estimates ("back calculation") of presumed BAC levels at the time of the accident or apprehension on the basis of measurements conducted later.

An important factor here is the change of BAC over time in the individual concerned. Immediately after ingestion the absorptive phase begins (in which absorption is faster than elimination) showing a maximum BAC between one-half and three

hours later, reportedly depending upon the amount of pure alcohol consumed, the amount and type of food in the stomach, drinking before, during or after food intake, the sweetness of the alcohol beverage, the time interval in which the alcohol was consumed, the concentration of alcohol by volume in the beverage, as well as the fat to lean ratio of the individual's body-build. These factors are believed not only to affect the steepness of the curve indicating the rate of increase of BAC during absorption but also the maximum BAC level that will be attained. This maximum is followed by the post-absorptive phase in which the metabolic processing (digestion and elimination) of alcohol predominates over absorption. There is evidence that the rate of elimination also shows considerable individual differences, presumably related to the enzyme activity in the liver. Often a horizontal BAC curve is found to last for several hours. In alcoholics the metabolic rate appears to be higher, sometimes by as much as 50%, especially after ingestion of large amounts of ethanol (3). These considerations explain the hesitance on the part of some experts to use simple arithmetic in determining whether or not an individual was beyond the legal BAC limit at the time of the incident.

Experiments with pharmaceutical products that might favourably influence the metabolism of alcohol (as well as the behavioural effects) have been carried out with fructose, insulin (22, 23) and dimenhydrinate (an antihistamine, 25), but the feasibility and beneficial effects of these "antidotes" remain to be demonstrated.

4. BAC and Behavioural Impairment

A major advantage of the technical possibility to determine blood-alcohol levels is the quantitative and objective nature of these measurements as compared to observational assessment of intoxication by police or other personnel. In order to establish the correspondence between these two types of diagnostic procedures of impairment, a number of studies have been carried out. It is reported that, on the basis of observation alone, physicians could identify only half of the individuals with BAC levels of 100 mg per 100 ml. Only at levels of 300 mg/100 ml were physicians correct in their observation that the individuals were under the influence of alcohol (26, 27, 28). In another investigation (29), it was found that police officers recognized 14 per cent of drivers impaired at .05% by wt., 29 per cent at between .05% and .10% by wt., and 53 per cent at BAC levels between .10% and .15% by wt.

Such findings suggest that "clinical" or observational judgements are grossly inaccurate, but is this an entirely fair inference? Theoretically, when considering the relationship between BAC levels and behavioural impairment, there are two types of possible discordance: those individuals who show low BAC's but are behaviourally impaired, and those persons who have high BAC's but fail to demonstrate observable signs of being affected by alcohol. There is reason to believe that the latter is characteristic of people who are used to drinking large amounts of alcohol (30, 31). In other words, it would seem that heavy drinkers are behaviourally far less impaired by alcohol than moderate drinkers. This would also appear to be in line with the idea that the longer the organism has been under the influence of alcohol, the greater is the ability of the central nervous system to adapt and to compensate for its effects. This is why several hours after the peak of BAC it is possible that an individual, even at a level as high as .15% by wt., shows few or no behavioural signs of being under the influence (22).

Certain impurities in some alcoholic beverages (e.g. Bourbon whiskey), the so-called congeners (such as fusel oil, isoamyl and isobutyl alcohol) have been found to influence vestibular function, nystagmus, decision making and risk perception over and above the effects of ethanol (32, 33). Detection of ethanol alone might thus overlook the presence of other intoxicants.

There are also indications that some effects of inebriation (e.g. nystagmus, reduced hand steadiness, body sway) persist after BAC has reached a level of zero (24). Hangovers may, therefore, also be associated with diminished fitness to make use of the roads.

On the basis of the above, justification may be found for the practical possibility to charge a driver for being impaired even if his BAC does not reach or pass a particular legal threshold (as is done in some countries) but it also becomes apparent why some experts hesitate to support the notion that excess of a particular BAC limit should automatically lead to a charge for driving while impaired.

5. The Involvement of Alcohol in Accidents and in Behaviour Related to Safety

To show that accident involved drivers have higher levels of blood alcohol than the driver population as a whole is to demonstrate that there is a functional relationship between alcohol and accidents. Several such studies have been carried out on the basis of road-side surveys, but documented evidence exists only for samples in six different countries (34, 24).

The findings suggest that for the driver population as a whole the risk of accident does not appreciably increase between BAC levels from zero to .05% by wt. when a comparison is made with the BAC level of accident involved drivers. From approximately this point onward the probability of accidents starts to increase and rises exponentially with the effect that a doubling of the blood alcohol level is associated with a risk increase considerably greater than a factor two.

However, if the total driver population is segmented into categories according to five classes of self-reported frequency of drinking (daily, three times per week, weekly, monthly, once a year or less), different patterns of accident risk associated with BAC levels emerge. A very marked risk increase is found already at BAC .06% by wt. in those who drink once a month or less. These "monthly" drinkers also show the steepest increase of accident risk as a function of BAC level, and they are the most likely of all categories to be involved in accidents also when they are sober (BAC less than .02% by wt.).

In fact, the average daily drinker has been found to be almost as safe at a BAC of .09% by wt. as a sober abstainer or near-abstainer. The former is safer, of course, if he has not been drinking at all (35). It is to be regretted that so few studies of this type have been carried out, because they are necessary to obtain better insight into the nature and the sometimes surprising ramifications of the problem, as well as into the generalisable validity of the results.

Findings such as these would seem to be in good agreement with laboratory and other experimental studies on the effect of different degrees of intoxication upon measures of performance (36). Even relatively low BAC levels turn out to be associated with measurable decrements in performance on such tasks as driving a stanchion course, choice reaction-time, divided-attention tasks, precision in viseo-motor performance, tracking during angular acceleration (37), manual dexterity, hand and body-steadiness, and short-term memory. Likewise, in many instances it is found that heavy drinkers are less impaired at rather low BAC levels than individuals who are moderate consumers of alcohol.

Although there can be no doubt about the positive association between the presence of alcohol and the occurrence of accidents, relatively little is known about the precise mediating role of alcohol. Does the presence of alcohol make accidents more likely to occur because of limited sensory functioning, because of unawareness of risks, increased willingness to accept risks, improper decision-making, or poor execution of manoeuvres? There is research evidence for the potential effect of all these possible mediating factors, but their relative contribution to increased accident likelihood is not known. Yet, this question is not without its importance. If, for instance, the most prominent effect of alcohol upon the functioning of the driver were found to be an intensification of glare and a slow recovery from it, both legal, engineering, and educational measures could be designed to specifically counteract this effect. At the same time other road users, e.g. the elderly drivers, would also benefit from these measures. This is why experiments on the effects of alcohol upon specific components of the driving task under real traffic conditions should be encouraged (38).

It is known that alcohol-involvement is over-represented in particular types of traffic accidents, such as head-on collisions and crashes resulting from loss-of-control (e.g. single-vehicle accidents), but more studies are needed to elucidate the specific alcohol effects, if goal-directed countermeasures are to be rationally derived. To give one more example; laboratory research has suggested that alcohol markedly interferes with sensitivity to events in the periphery of the visual field (39), but the contribution of this effect to the actual occurrence of accidents has not been established (40). Laboratory research is particularly adequate for the assessment of potential effects, but it cannot replace experimentation in the field if one wants to ascertain the proportional amount of influence of particular factors in real-life behaviour (41).

6. Legal Restriction and Penal Consequences: An Overview

6.1 Driving While under the influence of alcohol

Limitations on drinking-and-driving imposed by law differ markedly from country to country. Moreover, in some countries there are major regional differences depending upon the particular jurisdiction, and in many countries legal changes have been effected recently or are currently in the process of preparation.

While in some countries driving (42) is prohibited after any drinking of alcoholic beverages, in most cases the law refers specifically to driving while perceptibly under the influence of alcohol. This influence may be demonstrated in a variety of ways: behavioural signs, the presence of alcohol in the individual's organism or both. Many countries specify a legal threshold of BAC above which the individual is considered legally impaired, but these legal limits show a large variation from .05% by wt. to .15% by wt. between jurisdictions. Common values are .05, .08, .10, and .15% by wt. Moreover, in some jurisdictions, two standards are used (43), e.g. .05% and .15% by wt. (Sweden) or .08% and .12% by wt. (France) corresponding respectively to offences judged to be of different degrees of seriousness and punishable by different sanctions.

The presence of single or multiple legal thresholds does not always imply that a driver cannot be charged for driving while under the influence of alcohol if his BAC is found to be below the prevailing legal limit. In such cases the impairment is assessed on the basis of the manner in which the individual handles his vehicle, his demeanour when apprehended, and/or by observational tests carried out in a police station (walking a straight line heel to toe, picking up coins from the floor, looking up a number in the telephone directory, etc.).

In some jurisdictions only the evidence obtained on the basis of blood or urine tests administered by a licensed physician has legal validity, while in others, breath tests (subject to technical specification) applied by police personnel may be sufficient. Dual testing, a breath test first and, if resulting in a critical reading, followed by a mandatory blood test, is practised in some jurisdictions. However, in some countries, the driver may only be required to take a breath test if the apprehending police officer has reasonable grounds to suspect that the individual is under the influence of alcohol. In other countires such preliminary evidence is not necessary. In the latter case, any driver may be stopped by the police, regardless of his demeanour in traffic and be required to take a BAC test. Furthermore, in some countries, states, and provinces, portable road-side BAC screening devices may be used, prior to a

more elaborate test in a police station or medico-legal laboratory.

Following conviction the penalties in most jurisdictions may be either one or a combination of:

> Fines - with or without specified minima and maxima, usually between absolute amounts but in some countries prorated to the individual's annual income (minima one or 2.5 per cent, depending upon the level of BAC ascertained).
> Jail sentences - usually with specified minima and maxima, sometimes consisting of week-end imprisonment; some countries have special prisons for traffic offenders.
> Licence suspension - mandatory in some jurisdictions, not in others, usually specific minima and maxima; some countries cannot impose permanent suspension (revocation).
> Compulsory treatment - (for alcohol abuse) used in a limited number of jurisdiction; when there is a choice, and the individual opts for treatment, penalties are often reduced.
> Impounding of the vehicle - rarely applied.

The practice of giving stronger penalties for drinking and driving when it is followed by an accident exists in several countries, while more severe penalties are universal in the case of second and subsequent offences. Refusal on the part of the driver to take a BAC test is sometimes punished by fines, sometimes by licence suspension, a jail term, a combination of these or in other cases not punishable at all. In some cases, refusal to take a BAC test is followed by the same penal consequences as exceeding of the critical BAC limit.

Licence suspension is decided upon in courts in some jurisdictions, while in others it is a mere administrative measure on the basis of evidence obtained by the police or in the courts. In the former case the judge may rule a temporary relief of suspension to give the convicted individual an opportunity to drive his vehicle to and from his place of occupation or during his working hours. Purely administrative licence suspension does not allow this possibility.

The most immediate action taken anywhere is perhaps the so-called "curb-side suspension" of the driver's licence: policemen may at any time request the driver to surrender his licence when he has reason to suspect that the driver has consumed alcohol. The licence is returned to the driver immediately if a portable breath test shows his BAC is below .08% by wt., or else 24 hours later, while no further penalties ensue (44).

Re-instatement at the end of the period of suspension of the licence is automatic in this case, unlike the procedures followed in many other jurisdictions. In some countries one or several of the following conditions must be fulfilled:

Proff of proper liability insurance;
Successful driver re-examination;
A medical (psychiatric) certificate of fitness;
Passing a psychological (psycho-technical) examination (45).

As a result of these specifications, the period of suspension as imposed by the court may actually be only the lower limit of the restriction of the driver's right to operate a vehicle.

6.2 Other legal measures

The possibility of charging individuals other than those who operate a vehicle while under the influence of alcohol exists in various countries. Passengers in a vehicle who are aware of the fact that the vehicle operator has been drinking and do not attempt to prevent him from driving may be considered co-responsible for his act. The same holds true in some jurisdictions for individuals who serve alcoholic beverages to a person whom they know will drive a vehicle afterwards, or to those who entrust their vehicles to an individual who, to their knowledge has been drinking to a critical extent or more. In these and related cases invididuals other than the driver may be considered as accessories to the offence and be prosecuted accordingly or they may be entitled only to a reduced compensation when they, as passengers, are hurt in an accident in which the alcoholically impaired driver is found to be at fault.

Other regulations regard the selling or serving of alcoholic drinks to persons below a particular age or to those who by decree of court should not be allowed to obtain alcoholic beverages. The serving of drinks containing alcohol may be prohibited in restaurants and other food catering establishments along major highways and in built-up areas during certain hours of the day.

Some jurisdictions prohibit the carrying of unsealed bottles of alcoholic drinks in the passenger compartment of a car and/or drinking of alcohol in places other than licensed premises and private dwellings. Accordingly, drinking may be prohibited in public places as parks, streets, and beaches.

In some jurisdictions the sale of alcoholic beverages is limited to government operated outlets and thus excluded from grocery stores, supermarkets, variety shops, and the like. Total

prohibition has been in effect in some parts of the world in the past and it presently exists in some jurisdictions.

7. Deterrent Effects of the Law

7.1 Special deterrence

This term refers to the educational effect of a penalty upon an offender manifested by a desirable behaviour change after the penalty has been delivered to that person. This effect is distinguished from general deterrence which regards the preventative influence of the threatened consequences upon the population at which the legal command or prohibition is directed (46).

7.1.1 Licence suspension

It is well-known that relatively large numbers of those drivers whose licences have been suspended or revoked continue to drive. Estimates of the magnitude of this Phenomenon range between about one-third to seven-tenths of all drivers concerned. Moveover, the longer the period of disqualification, the more likely they are to disregard the licence suspension (47, 48, 49, 50). This does not necessarily mean that licence suspension has a negligible special deterrent effect. It may well be that the drivers concerned drive less, with greater care, and less often under the influence of alcohol than prior to licence suspension, although in one study it was found that about 5 per cent of drivers whose licence had been suspended because of driving after drinking were reconvicted for the same offence during the period of suspension (51). This percentage may seem small but it should be viewed in the perspective of the extremely low detection probability of the offence (see section *).

In the same study it was found that almost 40 per cent of all convicted drivers showed one or several cases of recidivism in a twelve year follow-up period. Particularly likely to commit the same offence (driving after drinking) again were those between 30 and 45 years of age and those persons who need their car for their work.

7.1.2 Jail terms

Juridictions with mandatory jail sentences for drunken driving, when compared with other areas in the same country where jail sentences are not mandatory fail to show lower recidivism rates (52). Not unlike what has been found with regards to licence suspension, the longer the jail sentence, the higher the recidivism rate. This does not imply a direct causal relationship - it might well be that those who are likely to re-commit the offence have characteristics that also lead to long jail terms - but it does mean that differential penal measures of this type fail to produce effective special deterrence. The size

of the penalty has not been shown to affect recidivism in a favourable sense.

7.1.3 Fines

The effects of fines, as far as they have been investigated, seem to show a somewhat different picture. High fines are found to be associated with a slight reduction in the extent of recidivism (53), but this result may be due to the fact that courts tend to impose heavier fines upon drivers with higher incomes. Higher incomes are associated with higher levels of education which in turn are correlated with a reduced tendency for recidivism.

7.2 Other Consequences of Penal Action

It is very much to be regretted indeed that studies on the effects of penal action upon the individuals involved are so sparse. In the absence of more relevant information on effectiveness, it is virtually impossible to redesign the system of enforcement, legislation, and punitive action in a way that is both rational and contains some hope for success. So far, the evidence suggests that the practical efficacy is markedly limited as far as recidivism is concerned.

However, there are also negative effects associated with prevailing systems in some countries.

The social, economic, occupational, and psychological consequences of licence suspension have been investigated by some authors (54). Forfeit of a job, mental stress, and financial losses are frequently much greater than when fines or prison sentences were given. The ensuing hardships in combination with the sometimes very long time delay between the traffic incident and the announcement of licence suspension (55) and the difficulties arising from efforts to get the licence re-instated after the period of suspension, produce strong feelings of hostility and resentment towards the legal system and the authorities, which not only overshadow the feelings of guilt and shame, but create a state of mind incompatible with effective education and rehabilitation. These reactions are frequently strengthened by the individual's awareness that undetected driving after drinking is so commonplace that he is put into a position of unwanted martyrdom for his fellow motorist. Hence the feeling that society has committed a crime against his person (56).

Specifically, drivers express major objections against lengthy periods of suspension and against the fact that the licence is withdrawn by some ('bureaucratic') administrative agency rather than the courts.

Conviction rates and penalties may vary between different courts because of particular procedures, attitudes and other biases. These become known to the police with subsequent effects upon the number and types of prosecutions which are issued for court action. Traffic cases constitute a large proportion of the work load of many lower courts and are regarded by judges as routine, dull, and a burden (57).

7.3 General deterrence

Investigations have been conducted in several countries on the effects of and the introduction of new, usually more severe, legislation regarding driving after drinking with or without the simultaneous utilisation of apparatus for the measurement of BAC levels. The results may be summarized as follows.

Measurements of BAC levels of drivers stopped at road-blocks show an appreciable decrement, especially among the lower levels. A reduction in the number of charges for driving while under the influence of alcohol may also be observed (58, 59) but in other cases charges may increase (6). From roadside surveys, it appears that moderate drinkers are more affected than heavy drinkers by such legislation (61). A similar pattern of results is found in drivers involved in fatal accidents (62, 63). A marked decrease in the total number of road fatalities was observed in one country (64), along with lower BAC levels in those who died, but in other countries such favourable results have not been found (60).

However, these changes, even if they do occur, do not seem to be characterised by permanency. After some time, the number of prosecutions return to "seasonal norms" (58) and fatal accident rates slowly return to previous levels (62). Legislation regarding drinking and driving may form no exception to the more or less general phenomenon of "regression towards the pre-existing trend" that would seem to characterise accident rates some time after the introductin of a new safety measure (65).

There are several reasons that may account for this. The introduction of a new law is usually widely announced by the mass-media and may given rise to a sharp increase in the general expectancy on the part of the driving public that police enforcement has been stepped up appreciably. After some time people may find out that this is not so. Another potential factor is the reaction of the police and the courts. When prosecution rates go up, juries become more hesitant to convict, judges more reticent to impose heavy penalties and police officers in turn become less inclined to charge (66), the

combined effect of these factors being a return to the original 'normal', base rates.

It is frequently assumed that new legislation and the accompanying mass-media publicity mainly affects the moderate and social drinkers, while problem drinkers and alcoholics are hardly influenced. It would be surprising indeed if the latter individuals were much influenced by factors such as legal threats, as their abuse of alcohol already testifies to their resistance to more immediate social pressures (and/or medication) from their families, their physicians, their job environment and so forth (67).

When prosecution rates increase and penalties are made more severe, the courts are faced with a considerable dilemna. Severe punishment is usually reserved for those crimes that are viewed as highly immoral by the citizens of the country who - however indirectly - determine the content of the law and the nature and magnitude of punishment. However, the perceived immorality of an act would seem to depend very largely upon the social deviancy of the behaviour involved. Rapid increases in the frequency of prosecutions may lead to a reduction in the perceived deviancy of the act and hence provide a lesser justification for severe punitive actions. This is one factor that might explain the reduced tendency to convict or severely punish when charges are laid and the reservation of heavy penalties for few cases. Other factors may be such practicalities as over-loading of the prison establishments (67) or rehabilitative facilities.

Consequently, in order to justify the severe penalties, either enforcement rates or the number of convictions have to be kept down. Out of this another dilemma arises. From an accident prevention point of view, a legal BAC limit of .05% or .08% by wt. may be too high, but if penalties are severe, these levels are too low to be truly enforceable and punishable. It may be argued that the current custom of severely penalising a small minority of the actual but largely undetected or unconvicted offenders constitutes an expedient, but basically unjustifiable, compromise that is bound to fail to produce significant general and special deterrent effectiveness.

8. Detection of Intoxicated Driving and Measurement of BAC

From the driver's point the general deterrent effect of legislation would seem to depend on:

- the probability of apprehension by a police officer;
- the probability of prosecution if apprehended;
- the individual's evaluation of the 'cost' of the penalty and the discomfort (shame, guilt, nuisance) associated with apprehension, prosecution and appearance in court.

A person who has been consuming alcoholic beverages may weigh the integral of the above factors against his estimation of the 'cost' of alternative behaviour to driving his car. The lower the estimation of the former and the higher the estimation of the latter, the greater is the likelihood that he will decide to drive his car. If he believes that alcohol increases the likelihood of having an accident, he may consider the probability and also the estimated cost when deciding whether or not to drive.

It is often assumed that the subjective probability of apprehension has a greater effect upon the individual's decision to drive or not to drive than other factors, including the size of the penalty. In various studies announcements of increased police surveillance have been found to be followed by increased caution on the part of the drivers (68, 69), and the increasing and subsequently decreasing effects of new legislation have also been attributed to this factor (see Section 7.3). The introduction of apparatus for the assessment of blood alcohol levels either in police stations or along the roadside would also seem to increase the subjective probabilities of apprehension and prosecution.

An additional advantage of this equipment is the possibility that it will reduce police bias in the apprehension of certain categories of drivers (70, 71), especially when roadside screening devices are used. Also, administration of breath tests implies consent on the part of the subject because these tests cannot be given in most jurisdictions.

The technical literature, (see supporting documentation) contains specifications of presently available equipment with regard to such factors as:

Test-retest consistency
Relationship to other tests
Calibration
Portability
Operational instructions
Temperature sensitivity
Quantitative versus pre-screening devices
Preservation of samples
Underlying chemical principles
Readings under sober conditions
Power supply
Costs

For full-quantitative devices a measurement accuracy of .01 at .10% by wt. can be obtained and this tolerance whould presently be considered as the maximum allowable inaccuracy (72). The technology of the measurement of the concentration of alcohol in blood and parallel procedures such as the analysis of breath samples is continually expanding so that care must be taken that the most advanced techniques are being used. Flaws in instrumentation or interpretation (e.g. "back calculation", see Section 3) will eventually become known to the public at large and therefore undermine the credibility of procedures used as well as complicating the actions in court because of greater sophistication of judges and defense lawyers.

However, the mere existence of BAC detecting devices is not sufficient to produce significant and lasting increases in the subjective probability of enforcement. The invididual's perception of the chances of being apprehended for driving under the influence is - among other things - dependent upon the actual probability of charges being laid.

This actual probability would seem to be very low indeed. A calculation of this probability would necessitate knowledge of the total number of kilometres driven while the driver is over the prevailing legal limit of BAC. The latter information is very sparse. A first approximation may be made by comparing the total vehicle kilometrage with the number of kilometres driven per charge is found to vary between 800,000 and 7.8 million kms with an average of 3.6 million kms (73). In countries where estimates of the percentages of 'drunk kilometres' exist, the total distance driven while legally intoxicated (or else .08%) per chage laid was recknoed to vary between 26,000 and 150,000 kms. One can go a long way indeed before bein caught!

Subjective estimates of apprehension risk seem to be much higher: Betweeen one charge in one thousand and one charge in one hundred trips (74) or even higher in the case of patently drunk driving (75), but these subjective probabilities are obviously not high enough to have a strong deterrent effect.

Ways must be found to increase individual awareness of the chances of being apprehended, such as intensified police surveillance and more frequent apprehension (76). The use of police cars hidden from sight may not be a very good strategy because it fosters public resentment against the police and it lowers the conspicuity of police on the roads.

However, should one arrive at the conclusion: The more enforcement the better? Giving the police the right to stop any car regardless of the overt behaviour of the driver, to institute frequent roadblocks, to arrest many drivers and to interupt and delay the trips of others, may very well result in undersirable side-effects in addition tc those already mentioned in Section 7.3.

As a consequence the police function may become viewed by the public as one of harassment and persecution rather than one of extending help and providing protection. It may add to the suspicion that police officers have to fill their ticket quota to make a promotion. Various studies seem to indicate that the increase of unpleasant contacts with the police on the part of many 'reasonably decent' citizens may have contributed to the so-called epidemic of 'decline of law and order' through a process leading from resentment and hostility to the police to sympathizing with the person arrested, to minimizing the seriousness of the offence and to a general decline in respect for the authorities, the highway code and regulations, and the law of the land (77).

Thus, it may be argued that a enforcement strategy of optimisation is to be preferred to maximisation of apprehension. It is more difficult to decide, however, where this optimum lies.

9. Educational Countermeasures

Various educational procedures are being used for the abatement of the problem of driving after drinking:

- Education of convicted drivers in the context of a course or of a treatment programme for alcoholics.
- The use of mass-media publicity in order to prepare the public to urge for or accept tougher legislation.
- The use of mass communications directed at road-users to reduce their driving with high levels of alcohol in their blood.

There is an unfortunate dearth of information with regard to the effectiveness fo these measures, as only few empirical studies have been carried out. Special courses for convicted drivers show encouraging results but the evidence is inconclusive (78). Evaluation of the effect of mass communications upon public acceptance and involvement in the modification of the law is presently in progress (79). The effect of mass media compaigns upon individual understanding and compliance with new or existing legislation regarding drinking and driving has been investigated in some studies (80). A recent publicity campaign in Edmonton, Alberta, Canada, conducted during the 'party season' at the end of the year was directed to hosts and hostesses, social drinkers and people in contact with deviant drinkers (81). Results were measured through road-side surveys before and after the campaign and compared with a control area. A significant drop in BAC levels was observed, across the entire range of the BAC distribution, including the higher levels. This may constitute a slight surprise to those who feel that very heavy drinkers cannot be influenced by such pressures as mass-media publicity. Perhaps this may be accounted for by the fact that the messages were also directed at those in the immediate environment of deviant drinkers, and they may have been affected by the benevolent spirit of the season.

Other research on the effectiveness of mass publicity campaigns for the promotion of traffic safety has resulted in the identification of a number of desirable features of these campaigns (80). Campaign effectiveness seems to be considerably enhanced when the message is instructive in the sense that the audience is told unambiguously and explicitly what behaviour is wanted. Another important component is immediacy, that is the message should preferably reach the recipient at the very time and in the very place in which the advocated behaviour is relevant and may be translated into the desired conduct without delay. Also, it has been observed that the content of the message should be perceived by the individual as personally relevant to him, rather than to the 'other fellows' on the road. Imaginative attempts to incorporate these components into publicity regarding drinking and driving seem to be in order.

Almost 50 per cent of those drivers stopped in one series of roadside surveys (82) who had higher than zero BAC levels reported they had been drinking in bars (42%) or restaurants (2.5%). Like fire regulations posted in these buildings, warnings pertaining to drinking and driving might be placed on the walls of washrooms and the like. Bottles and other containers of alcoholic beverages might be marked with cautionary texts (83) comparable to the mandatory warnings imprinted on cigarette packages and certain medications in some countries. Television and radio broadcast messages intensified during the hours of drinking and subsequent driving might also enhance immediacy.

With regard to specific instructiveness, certain problems must be noted. It may be unrealistic to demand complete abstinence before driving in those countries where alcohol consumption is common, private car ownership is almost universal, and public transportation is poor. Yet, from what is known about the effects of alcohol upon human behaviour and the likelihood of accidents it may be impossible to specify responsible amounts of alcohol consumption in view of the major individual differences (see Sections 3, 4 and 5) in response to a particular quantity of ethanol. Advice such as "have a maximum of two drinks an hour, and never more than four altogether", may fulfill the requirement of instructiveness but if followed blindly, will increase the chances of having an accident more in the rare drinkers than in the daily drinkers. The resulting BAC level will also differ greatly between individuals. Obviously, it is impossible to explain all details of alcohol metabolism and accident likelihood in a relatively simple and comprehensive message, and yet, one does not, how can one make the message valid, instructive, and credible?

These issues, however, might be treated in the context of driver training and it has also been suggested to insert questions on these topics in driver examination before a licence to drive is obtained.

10. Miscellaneous Contermeasures

Some countries have a so-called demerit or penalty points' system in which infractions and violations are valued according to their seriousness and added in a cumulative manner over time. Although not specifically aimed at alcohol related violations, the latter are included in the total number of penalty points accumulated by the driver. Certain actions may be taken by the (administrative) authorities as soon as a particular number of points has been reached: Warning letters, interviews, remedial driver training, and licence suspension. From the few studies that have been conducted in order to evaluate the special deterrent effects of these systems, it would appear that effectiveness very largely depends upon what is done to the driver in question. A personalised, non-threatening, and re-educative approach would seem to yield the best results (64).

Insurance companies sometimes refuse payment of damages if the driver responsible for the accident was found to be intoxicated. It has not been investigated if this practice has any preventive effect upon driving after drinking, but it is known that very considerable hardships may follow for those who seek compensation and feel they are entitled to it. No-fault insurance is likely to remedy this unfortunate situation.

The very considerable increase in insurance premiums which sometimes follows an accident in which alcohol is present, may have some- but as yet unknown - deterrent effect, but there is some evidence that stepped-up premiums induce some individuals to drive without insurance altogether. Here again, the ensuing advantages to insurance organisations must be viewed in the perspective of the resulting costs, financial and otherwise, to others. Some insurance companies offer reduced premiums to self-declared abstainers and rebates to drivers for specified periods of accident-free driving. It may be that these rebates have some incentive effect on cautious driving, but it would seem that discounts will have to be quite considerable and noticeable to drivers in order to have the desired effect. As the concept of attaching positive consequences to the exhibit of desirable behaviour appears to be a sound one, the development of other rewards for accident-free driving should be strongly encouraged.

Prospective countermeasures on a rather different level include ignition lock devices that open only after the driver has successfully carried out a short-term memory or psychomotor task. One problem with these automotive features to prevent a person from starting a car is that they are strongly influenced by learning effects. Repeated practice on these "pre-driving tests" will defeat their original purposes and serve the driver's less desirable intentions. Another problem is that persons other than the intoxicated driver might attempt to get the engine started.

In some countries special non-alcoholic beverages have been produced, marketed, and advertised to replace ethanol containing drinks. These alcoholic-free 'beers' and 'wines' have not shown very successful sales. The marketing of a strong-tasting, bitter or tangy non-alcoholic drink has been proposed as an appropriately masculine, 'boisson de pilote' (85).

Frequently, the unfortunate social reality is that an individual who refuses a drink in company indirectly condemns others who continue to drink, thereby provoking them to talk the individual into yet another glass. Ideally, therefore, countermeasures, legal and otherwise, should be arranged in such a way as not only to affect the individual's position vis-à-vis the law, but the very pattern of social interaction in which drinking takes place. Making individuals other than the actual drinking driver liable to prosecution, by considering them accessories to the act, may be construed as one effort in this direction. It may be argued that for <u>legal</u> deterrents to be effective, they must enhance the prevalence of <u>social</u> control of the behaviour in question on the level of habitual face-to-face interactions within groups in the community.

11. Evaluating Countermeasure Effectiveness

In the preceding sections frequent reference has been made to countermeasures, the effects of which are entirely unknown, as well as to activities that raise serious doubts regarding their possible beneficial effect upon traffic safety. In the rare instances of countermeasure evaluation against empirical standards, few activities seem to have had favourable results. In the majority of those cases in which countermeasures to tests of their actual impact. Thirdly, effective activities are not as easy to design as may have appeared in the past, and fourthly, whatever countermeasure is implemented, it should be verified on its results before major confidence is placed in its effectiveness.

Only through empirical assessment of countermeasure results may a particular country or jurisdiction profit from the experience obtained in that area or elsewhere. Only by virtue of different activities implemented in different areas can one hope to determine their differential efficacy, although findings obtained in one country may not necessarily be entirely valid elsewhere. No major countermeasure activity should go unaccompanied by research into its effectiveness, or else nothing will be learned for future action or application.

The effect of any measure aiming at the reduction of the role of alcohol in traffic accidents may be assessed in a variety of ways:

(a) A reduction in the fatal, personal injury, and property damage accidents following the introduction of the countermeasure;
(b) A reduction in the presence of alcohol in drivers involved in fatal and other traffic accidents (either at fault or not);
(c) An over-all reduction in average BAC levels in the road-using public at risk, i.e., those using the roads, but not necessarily involved in accidents;
(d) A reduction in those higher BAC levels considered to be critical in contributory effect to traffic accidents;
(e) An increase in the public's knowledge of the dangers associated with high BAC levels;
(f) An increase of the public's knowledge of the laws (regulations and penalties) regarding driving after drinking;
(g) An increase in the public's acceptance of these laws.

The criterion of effectiveness mentioned under (a) is obviously the most pertinent, but as a practicable yardstick in research on countermeasure effectiveness it has certain disadvantages, because the appropriate statistics are gathered slowly and changes in accident tolls may be due to other

concomitant factors (e.g., weather, seasonal variations, economic fluctuations, road engineering, other legislation, increased seat-belt usage, and so forth). The criterion mentioned under (b) only reflects effectiveness validly if criterion (a) is also fulfilled or else it may be inferred that the decrease of alcohol-related crashes is simply offset by an increase in other categories of accidents (see Section 12). Another problem with this criterion is that, even if there is a substantial reduction in criterion (a), the percentage of drivers with high BAC levels among those killed theoretically might increase at the same time (87). Effects listed under (e), (f), and (g), are limited in significance because of the notorious lack of correspondence between the verbal expression of knowledge and attitudes on the one hand and actual behaviour on the other (88).

On the basis of these considerations it may be proposed that the effects mentioned under (c) and (d) are the most practical indeed for the purpose of the assessment of effectiveness of countermeasures regarding driving while under the influence of alcohol. Measurements of the blood alcohol levels in the population of drivers have been carried out in a number of countries and an appropriate methodology for this type of assessment procedures has been developed (89). The technique of road-side surveys of BAC levels can be very meaningful, especially if certain precautions are taken with regard to the minimising of refusal rates, and especially sampling procedures. The latter constitute a complex problem because of the enormous variations in the distribution of BAC levels between sampling sites, season of the year, holidays, day of week, and time of the day or night. Volume of passing traffic must also be taken into account if one wishes to arrive at a representative estimate of the entire driving population in terms of BAC levels (90).

Earlier investigations have suffered from shortcomings in this respect. When this technique is used, one should also avoid other complications such as associated with the (il) legality of stopping drivers who 'drive normally', the potential accident eliciting features of road-blocks (91), the possibility that knowledge of road-blocks at certain places will induce some drivers to avoid these spots, and finally the damage to police-public relations which may ensue. Road-side surveys, if properly conducted, provide an excellent intermediate criterion for the effectiveness of countermeasures, and they deserve much wider application than has hitherto has been the case. More extensive use of this method will also give more detailed information on the question how changes in the BAC distribution in drivers on the roads relate to the ultimate criterion of countermeasure effectiveness, that is the reduction of fatal accidents, personal injuries, and property damage.

12. Conclusions and Recommendations

Any rational development of remedies for the problem that arises from driving after drinking should take account of the potential limitations, repercussions, and undesirable side-effects that may interfere with the efficacy of the countermeasure under consideration. Most remedies introduced hytherto imply a major or minor action upon the complex fabric of values, cognitions, and habits of the population in general or of particular sub-broups, thereby eliciting an array of reactions from the public.

These responses, after some time lapse, sometimes feed back upon the operations and decisions of the very authorities that instigated the original change or upon other elements of the system thereby annulling or at least reducing the intended effects of their actions. Thus, it has been observed that the introduction of stiffer penalties may be followed after some time by a reduction in the tendency of the police to apprehend, of juries to convict and of judges to impose severe punishment. As a consequence the conviction rates for driving while under the influence return to the pre-existing trends at the end of the period taken by the social and legal system to adapt to the new rules.

The long-term inefficacy of these new rules must be attributed to a number of factors. It may be that the rule is not in agreement with the public's notion of justice, for instance because the law stipulates strong penalties for behaviour that is quite common and therefore not deviant enough to be considered truly immoral. The courts and the police force, being a part of the society in question, become hesitant to apply the law to its full extent. Few harsh sentences are the result. Even when imposed, the strong penalties fail to produce a re-educative effect upon the individuals concerned because the design and operation of the legal process are not conducive to an effective and remedial learning process on the part of the offenders. More severe punishment does not change the individual to the extent that he will become less likely to commit the offence again.

Even if the special deterrent effect of the law were maximal, the total reduction in accidents would be limited. This is because only a relatively small percentage of all accidents occur to individuals who have prior accidents or violations. It has been calculated that more than 95 per cent of all accidents in a two-year period would still happen if all individuals who had three or more violations in the preceding two years were removed from the roads. Similarly, less than five per cent of all accidents would not occur in a three-year period, if all individuals who had two or more accidents in the preceding period of three years no longer drove (92).

Consequently, whatever may be achieved through the special deterrent actions of the law should be viewed in the proper perspective of the total accident problem.

This is why the general deterrent effects may be considered more promising when a substantial improvement in traffic safety is the aim. Here again, the size of the penalty seems to be of little consequence, at least when driving after drinking is considered. Rather, the driving public seems to be most responsibe to their subjective estimates of the risk of being apprehended. Considerable preventive effect may be expected from measures that increase the public's perception of the chances of being apprehended for driving after drinking. To have a lasting effect, the subjective apprehension risk should be maintained at a high level, and the consequence of apprehension should be perceived as quite unpleasant. This means that the critical BAC level should be high enough to consistently lead to arrest, conviction and punishment. If the level were set relatively low, it would lead to so many potential arrests that the law cannot be enforced, either physically or morally.

However, if the critical BAC level is set relatively high, then the calculated potential benefits for accident reduction will be correspondingly reduced (93).

Even if this dilemma were satisfactorily resolved, other problems are likely to remain. A countermeasure succeeding in preventing alcoholics from drinking but not from driving might not fully reduce their accidents to an average level because of the presumed proneness of alcoholics to have accidents even when sober. Alternatively, a countermeasure that successfully reduces driving by alcoholics and problem drinkers after drinking but that does not affect their drinking, may have no beneficial effect upon the number of fatal accidents incurred by these individuals as pedestrians, or while they are driving during a hangover. Also their mortality due to accidents in other situations than traffic would not be favourably affected.

If countermeasures are introduced in a manner that leads to an emphatic pinpointing of alcohol as the main culprit in fatal and other serious accidents, large segments of the driving public (the 'sober drivers') might be led to believe that they have not major responsibility in the cause of accident avoidance. Blaming accidents on a single cause and the ensuing reaction of 'scape-goating' the intoxicated drivers as the most culpable in the road accident problem, might well result in reduced caution while driving on the part of large segments of the 'sober and generally law-abiding' citizens (94). Finally, if countermeasures effectively curtailed road accidents over a certain period of fime, the resulting awareness of the driving public that 'the roads are no longer as dangerous as they used to be' might lead to reduced caution in some drivers and

consequently contribute some momentum to a regression of pre-existing trends of accident statistics (95).

In the absence of more detailed research data it is presently not possible to make the necessary quantitative estimates of the gains and losses associated with the above factors in any particular part of the world. They are, nevertheless, important considerations in the planning of countermeasures and the assessment and interpretation of their effects even if future evidence shows that they actually were of lesser relevance.

Countermeasures have to be designed and executed in the light of what is presently known and whatever considerations emanate from the current state of information. As it is evident from this report that, in many respects, solid information is lacking on the direct and indirect or delayed effects of countermeasures implemented in the past, an experimental, explorative, and research-oriented approach is more warranted at the moment than the formulation of definitive, doctrinaire and inflexible verdicts in the domains of law, public education and in other areas in which countermeasures may be conceived. It is in this spirit that the following conclusions and recommendations are presented.

12.1 Legal BAC limits

Legal BAC limits are desirable because they can facilitate enforcement, reduce the ambiguity of the notion of impairment, diminish police bias in laying charges, expedite action in court, and they are easier to ascertain than other indications of driving while under the influence of alcohol. From an accident prevention point of view they should be set as low as possible, but in order to be enforceable they have to be set rather high. Moreover, if they are to have a general deterrent effect, the chosen limit should be enforced ubiquitously and lead to consistent consequences for the individuals involved. In order to make this possible, a dual limit may be considered, so that at least the higher one can be near-universally enforced in a way compatible with popular notions of justice, and it may (therefore) actually have a special and general deterrent effect. Using the concept of progressive approximation, this higher level - when shown effective - may be brought down in time to a somewhat lower maximum legal limit in order to become more compatible with traffic safety requirements. Some time later this process of lowering the legal BAC limits may be repeated, and so successively.

12.2 Increasing subjective apprehension risk

The general deterrent effect of the law seems to depend more upon the public's estimate of the chances of apprehension than of the severity of the penalties. Consequently ways must be sought and implemented to increase subjective apprehension risk. For this purpose the conspicuous presence of the police force on the roads ought to be maximised. The police should also be equipped with portable roadside screening devices for the detection of BAC.

A decision will have to be made on the matter of necessary or unnecessary presumptive evidence on the part of the police officer. This should be stipulated in agreement with the laws, customs, and values of the country in question.

It is important that the possibility of laying charges for driving while under the influence be retained even if the measured BAC level does not exceed the legally critical reading.

12.3 Improving the legal process

The total process of apprehension-prosecution-conviction should be designed in order to facilitate learning and behaviour change on the part of the public. Quick justice is effective justice, provided there are appropriate opportunities for appeal. Thus, it is definitely necessary to expedite the legal process. This may be achieved by such procedures as short-term roadside licence suspension and other measures that provide immediate punishment after the act.

Another important requirement is that legal action be in agreement with public feelings of what constitutes a crime (offence) and what punishment is fitting in relation to its judged seriousness (96). Social surveys should be conducted to find the answers to these issues. The practice of delivering more severe penalties as the consequences of the act become more serious, rather than on the basis of its intrinsic demerits, should be scrutinized. It may not be in agreement with public notions of morality to punish an intoxicated driver more for hitting a pedestrian than colliding with a tree. For similar reasons punishment (e.g. licence suspension) through simple administrative measures rather than by the courts and the police, may be inadvisable.

If fines are to be imposed, they should be proportional, linearly or, even better, progressively, to the offender's annual income. In order to protract the learning experience of the individual involved, these fines should be made payable in installments.

In case of repeated offences, the driver should referred to a special course for intoxicated offenders, to a clinic for the treatment of alcoholism or to another appropriate agency. The process of law should be effectively integrated with the preventative and remedial work done by such agencies.

12.4 Accessories to the offence

The law should be formulated and executed in such a way that it not only deals effectively with regards to offenders as individuals, but actually impinges upon the social interaction patterns in which drinking followed by driving takes place. This may be achieved by much wider use of the concept of co-responsibility of those who serve drinks, ride as passengers, but who do not make an active attempt to prevent the offender from driving. These individuals should be considered as liable to prosecution for being considered as accessories to the act, and the existence of this rule should be widely publicised.

12.5 Special traffic courts

The present legal functioning must be considered as unsatisfactory for a great variety of reasons discussed in this report. Rationalisation and greater effectiveness may be expected if judges and other personnel were better informed of the ramifications of the role of alcohol in the road safety problem, if they had more interest in the cases they see in court, kept abreast of research findings in the area, instigated novel approaches, and worked in close contact with other social and medical agencies involved in safety promotion.

These goals may be achieved through the establishment of traffic courts, especially equipped for the handling of traffic cases.

12.6 Expanding research efforts

As yet we do not know exactly how alcohol interferes with fitness to drive. As a consequence countermeasures cannot be designed with great rationality and precision. The effects of countermeasures that are available are often not well understood. They owe their existence often more to speculation, doctrine and ideologies than to empirically verified proof of effectiveness.

Thus, research activity in the area of driving after drinking should be greatly increased and funds should be made available and research personnel recruited to match the seriousness of the problem. The introduction of any countermeasure should be accompanied by appropriate investigation of its impact. The road-side survey technique is one of the methods that should be applied more frequently.

12.7 Public education

The general public should be made more aware of the risks they incur if they drive after drinking, of the risks they and others incur because of the presence of drinking drivers on the road, of the law, of alternative to drinking alcohol at parties and other social events, and of the misleading detoxificant effects of coffee, exercise, showers and the like. Mass communication campaigns should be conducted accordingly, and be designed in agreement with what is presently known about the effective use of mass publicity for the modification of road-user behaviour.

Bottles and other containers of alcoholic beverages should be provided with warnings regarding the use of their contents.

Bars, restaurant, and similar establishments should be made to post warnings concerning driving after drinking.

Present information on the role of alcohol in traffic accidents should be incorporated in driver training and driver examination should include questions pertinent to these issues.

12.8 The responsibility of the news media

Road collisions are rate events in the life of any particular individual and therefore they give him little opportunity to learn to avoid them. A person might however learn from the road collisions incurred by others if the relevant information of contributing factors is made available. Ideally therefore, accident reports in newspapers, radio, and television - reports that enjoy a high degree of public attention - should be presented in such a way as to maximise the opportunity for learning.

It is recommended, therefore, that journalists and other reporters be persuaded to include relevant information such as the present of alcohol, the use of seatbelts, the particular manoeuvres made and so forth, in their news reports. A way must be found to avoid issues of prejudicial or otherwise incriminating accounts of accidents.

12.9 Reward versus punishment

It is generally agreed, on the basis of research evidence in a great variety of behaviour domains, that punishment has a minimal and temporary effect upon the behaviour concerned, unless there are meaningful alternatives to the individual involved. The improvement of public transport services especially in the hours of frequent drinking might constitute

such an alterntive and therefore, have a considerable beneficial effect upon road safety.

On the other hand, the rewarding of desirable behaviour has been found to produce consistent and long-term behaviour changes that outlast the period in which the rewards are actually given. Thus, implementation of sensible incentive systems may well lead to a general improvement of behaviour on the roads and in the streets. Discounts in insurance premiums already exist in some areas, but it would seem that there is ample room for improvement and expansion in the potential use of this concept.

Notes:

1. Voas, R.B. Vehicle violence: An American tragedy. MRI Quarterly, 425 Volker Boulevard, Kansas City, Missouri, 64110, U.S.A.

2. Huelke, D.F. and Davis, R.A. Pedestrian Fatalities. Highway Safety Research Institute, University of Michigan, Ann Arbor, Michigan, U.S.A., 1969.

3. See the 1968 Alcohol and Highway Safety report to the U.S. Congress. U.S. Government Printing Office, Washington, D.C., U.S.A., Page 153.

4. See the reference mentioned in note 3.

5. Waller, J.A. Identification of problem drinking among drunken drivers. Journal of the American Medical Association, 1967, 200, 114-120. Also see Selzer, ML. Personality versus intoxication as critical factor in accidents caused by alcoholic drivers. Journal of Nervous and Mental Disease, 1961, 132, 298-303, and the reference mentioned in note 1.

6. Four per cent of the population does not equal four per cent of the driver population because of the sub-group of skid-row type of alcoholics who frequently do not own cars. Also see note 1.

7. Buikhuizen, W. Alcohol en verkeer: de feiten (Alcohol and traffic: The facts). Chapter One in Buikhuizen, W. (ed.). Alcohol en verkeer (Alcohol and Traffic), 1968, Boom en Zoon, Meppel, The Netherlands.

8. See note 39. The authors also refer to studies of BAC levels in victims of fatal accidents in Germany conducted by Schleyer, by Elbel and Burkardt.

9. L'Hoste, J. Quelques résultats de recherches menées en France à propos de l'impregnation éthylique des conducteurs. Proceedings of the Conference on medical, human and related factors causing traffic accidents, including alcohol and drugs. Montreal, May 30 - 31, 1972. Published by the Traffic Injury Research Foundation of Canada, 74 Stanley Avenue, Ottawa, Ontario, Canada.

10. The possibility of these statistics being somewhat inflated because of a reduced likelihood of surviving an accident when there is alcohol in the victim's blood, has not been considered in this review.

11. Selzer, M.L., Payne, C.E., Westervelt, F.H., and Quinn, J. Automobile accidents as an expression of psychopathology in an alcoholic population. Quarterly Journal of Studies on Alcohol, 1967. 28, 505-516.

12. Willett, T. Sociological and criminological factors in road traffic offences. Procedings of the Symposium on Human Factors in Road Traffic. Department of Justice, Stockholm, Sweden, 1971, 7-26.

13. Buikhuizen, W., Dijksterhuis, F.P.H., and Zweens, J. Personnlijkheidshenmerken van de rijder onder invloed (Personality traits of individuals who drive while under the influence of alcohol). Chapter Six in the same book as mentioned in note 7.

14. Smart, R.G. Are alcoholics' accidents due solely to heavy drinking? Journal of Safety Research 1969, 1, 170-173. Also see Waller, J.A. Impaired driving and alcoholism: Personality or pharmacologic effect; in the same issue of this Journal for a further discussion of this topic, as well as Smart's reply.

15. Gilbert, J.A.L. Collection of baseline data on effect of alcohol consumption on traffic accidents. Paper presented at the same conference as mentioned in note 9.

16. Brenner, B. Alcoholism and fatal accidents. Quarterly Journal of Studies on Alcoholism, 1967, 28, 517-528. Alcoholics when matched with members of the general population were found to meet with death 4.5 times more often in traffic, 16 more times often as a result of a fall, 30 times more often due to accidental poisoning, and 3 times more often in other types of accidents.

17. See note 2.

18. Wechsler, H., Kasey, E.H., Thum, D., and Demone, H.W. Alcohol level in home accidents. Public Health Reports (USA), 1969, 84, 1043-1050.

19. See note 9.

20. See note 34.

21. Barmack, J.E., and Payne, D.E. The Lackland accident Countermeasure experiment. Highway Research Board Proceedings (USA), 1961, 40, 513-522.

22. Froentjes, W. Het bewijs van alcoholgebruik; methoden ter bepaling van het alcoholgehalte in het bloed. (The proff of alcohol consumption; methods for the assessment of blood alcohol concentration) and Factoren van invloed up de hoogte van het bloed-alcoholgehalte (Factors influencing the level of blood alcohol concentration). Chapters 2 and 3 in the book mentioned in note 7.

23. (a) Gruener, O.G. Der Gerichtmedizinische alkoholnachweis (Medico-legal evidence of alcohol consumption), 1967, Carl Heyman Verlag, K.G., West Germany.

(b) Havard, J.DJJ. Value and deficiencies of studies on BAC's among dead and injured. Paper presented at the conference mentioned in reference 9.

24. Goldberg, J. Interaction of alcohol and drugs and traffic safety. Paper presented at the same conference as mentioned in note 9.

25. "Antihistamine fails to produce 'instant' sobriety". The Journal, June 1, 1973, p. 12, published by the Addition Research Foundation, 33 Russell Street, Toronto 179, Ontorio, Canada.

26. Borkenstein, R.G., Crowther, R.G., Shumate, R.P., Ziel, W.B., and Zylman, R. The role of the drinking driver in traffic accidents. Department of Police Administration. Indiana University, Bloomington, Indiana, March 9, 1964.

27. Haddon, W., and Brades, V.A. Alcohol in the single vehicle fatal accident. Experience of Westchester County, New York. Journal of the American Medical Association, 1959, 169, 1587-1593.

28. Davis, J.H. and Fisk, A.J. The Dade County, Florida, study of carbon monoxide, alcohol and drugs in fatal signel vehicle automobile accidents. Dade County, Florida, Coroner's Office; Proceedings of National Association of Coroners, 1964-1966, 197-204.

29. A study by Dr. H. Klette (Sweden) quoted by Farmer, P.J. Review and evaluation of legislative and enforcement programmes related to the use of alcohol and other drugs. Paper presented at the same conference as mentioned in note 9.

30. Smart, R.G. and Schmidt, W. Traffic accidents of alcoholics. Published by the Addiction Research Foundation, Education Division, 344 Bloor Street West, Toronto 179, Ontario, Canada.

31. Hurst, P.M. Blood alcohol and highway crashes: A selective review of epidemiological findings. Institute for Research, State College, Pennsylvania, USA, October 3, 1972.

32. Katkin, E.S. and Hayes, W.N. Differential effects upon reaction time and perceptual motor performance of alcoholic beverages differing in congener content. Proceedings of the 75th annual convention, American Psychological Association, 1967.

33. Teger, A.I., Katkin, E.S. and Pruitt, D.G. The effect of alcoholic beverages and congener level on level of risk taking. Department of Psychology, State University of New York at Buffalo; Paper presented at the meeting of the Eastern Psychological Association, April 20, 1968.

34. Stroh, C.M. Roadside surveys of drinking-driving behaviour. Paper presented at the same conference as mentioned in note 9.

35. See note 31.

36. Wilde, G.J.S. and Curry, G.A. Psychological aspects of road research: A study of the literature, 1959-1968. Published by Road and Motor Vehicle Traffic Safety, Ministry of Transport, Ottawa, Ontario, Canada, 1970.

37. Collins, W.E., Gilson, R.D., Schroeder, D.J., and Guedry, F.E. Effects of alcohol on tracking performance during angular acceleration. Journal of Applied psychology, 1971, 55, 559-563.

38. Scheneider, W. Rijden onder de invloed: een experiment (driving under the influence; and experiment). Chapter 5 in book referenced in note 7.

39. Buikhuizen, W. and Jongman, R.W. Kijken onder invloed (Visual perception under the influence of alcohol). Wolters-Noordhoff Groningen, the Netherlands, 1970. Also available in German: Der Einflusz des Alkohols auf das wahrnehmen von Verkehrssituationen (The influence of alcohol upon the perception of traffic situations). Published in the series Faktor Mensch im Verkehr, Dr. Arthur Tetzlaff Verlag, Frankfurt am Main, West Germany, 1971.

40. The study mentioned in note 38, for instance, shows no significant difference in the accuracy of perception of other traffic while the subjects were driving the route with an average BAC level of .13% by wt. (in dual control cars), but they made other types of errors. Also, although undoubtedly many traffic relevant cues are perceived auditorily by drivers, there is no evidence that deaf drivers are actually worse accident risks.

41. Chapanis, A. Human Factors in Systems Engineering. Chapter Two in DeGreene, K.B. Systems Psychology 1970, McGraw-Hill, New York. Also see by the same author: The relevance of laboratory studies to practical situations. Ergonomics, 1967, 10, 557-577.

42. 'Driving' does not always necessarily mean being in the process of controlling a moving vehicle. Being in charge of a stopped vehicle with the key in the ignition lock may be subsumed in the same category as driving.

43. In Australia new legislation is geing considered to include three critical BAC limits, .05, .10, and .15% by wt.

44. Hooper, A. Curbside licence suspension. Criminal Law Quarterly (Canada), 1967-1968, 10, 22-25. The licence may also be reinstated immediately by the apprehending police officer if he is satisfied that the life of a person will be endangered by the delay involved in undergoing the BAC test.

45. 'Psychotechnical' examination is an expression commonly used in Europe for psychomotor skills, intellectual functioning, personality traits, and so forth.

46. The rationale for the law that deals with moral retribution for wrongdoing will not be considered in this report. Only pragmatic effects and implications are discussed.

47. Klette, H. Om social kontroll av grovre trafikbrottslighet. (On legal control of serious traffic offences). Departments of Law and Sociology, University of Lund, Sweden, 1972.

48. Buikhuizen, W. Strafmaat en recidivisme (Size of Penalty and recidivism). Chapter Eight in book referenced in note 7.

49. See note 51.

50. Coppin, R.S. and Van Oldenbeek, G. Driving under suspension and revocation, Report No. 18, Research and Statistics Section, Division of Administration, California Department of Motor Vehicles, Sacramento, January, 1965.

51. Buikhuizen, W. and Van Weringh, J. Voorspellen van recidivisme (The prediction of recidivism). Chapter Seven in same book as mentioned in note 7.

52. See same references as mentioned in notes 48 and 12.

53. Same reference as in note 48.

54. Same reference as those in notes 12 and 47.

55. Buikhuizen has investigated the relationship between the time lapse between charges being laid and court ruling and the extent of later recidivism. Longer time lapses were found to be associated with a greater incidence of recidivism. See Chapter Ten in the publication referred to in note 7.

56. The feeling of being 'picked upon' may also be aggravated by the offender's awareness of existing police bias against young male members of the working class. See reference in note 12.

57. Effects of the enforcement of legislation on road user behaviour and traffic accidents. Report prepared by Research Group S6 of the Road Research Programme. Organisation for Economic Co-operation and Development. Paris, OECD publications (in press).

58. Same reference as in note 44.

59. Hooftman, J.C. Het strafrecht en het rijden onder invloed (Criminal law and driving under the influence). Chapter Nine in same book as mentioned in note 7.

60. For instance in Canada; see Farmer, P.J., Review and evaluation of legislative and enforcement programmes (paper presented at the conference mentioned in note 24) and a more recent and comprehensive report by Carr, B.R., Goldberg, H., and Farbar, C.M.L. The Breathalizer Legislation: An inferential evaluation. Road and Motor Vehicle Traffic Safety, Ministry of Transport, Ottawa, Canada, 1973.

61. Same reference as in note 9.

62. Same reference as in note 23 (b).

63. Perrine, M.W. Collection of baseline data on effect of alcohol consumption on traffic accidents. Paper presented at the conference mentioned in note 9.

64. If one assumes that legislation has little influence upon alcoholics and problem drinkers, and if it is true that a disproportionate share of fatal accidents is incurred by these people, it is somewhat surprising that the British Road Safety Act of 1967 has had a very marked reducing effect upon road fatalities.

It may be that one or both of the above assumptions are not valid, at least not universally. Note 81 refers to a study in which a general decline of BAC levels across the full BAC continuum, including the higher readings, was observed following a mass communication campaign. Also see the materials in Notes 23(b) and 63 for a discussion of these matters.

The British experience is reviewed in Beaumont, K. and Newby, R.G., British Counter-measures to the Problem of Alcohol and Drugs in Road Safety, which is a summary paper of the authors' contributions to the International Symposium on Counter-measures to Driver Behavior under the Influence of Alcohol and other Drugs, arranged by the OECD and the British Medical Association in London, during September 1971.

A comprehensive account and interpretation of the British findings is given by Ross, H.L., Law, Science and Accidents: the British Road Safety Act of 1967, Journal of Legal Studies, 1972, 2, 1-78, published by the American Bar Association, 1155 East 60th Street, Chicago, Illinois, 60637. This publication contains a thorough discussion of the

57<

various factors that may have contributed to the effectiveness of the act in reducing fatal accidents as well as to the emergence of several side-effects. Ross argues that the initial effect of the legislation was largely due to a reduction in driving by social and occasional drinkers as a result of a sharp increase in subjective apprehension risk following mass-media publicity calling attention to the new law. The subseuqent progressive reduction in effectiveness of the law is attributed by Ross to the consideration that subjective apprehension risk, after a marked increase, started to decline as it was not substantiated by actual experience on the part of motorists.

65. Wilde, G.J.S. General survey of efficiency and effectiveness of road safety campaigns: Achievements and challenges. Paper presented at the International Congress at the occasion of the 40th anniversary of the Dutch Road Safety Association, the Hague, October 19-20, 1972.

66. Cressey, D.R. Law, order and the motorist. Paper presented at the Bristol Seminar on the Sociology of the Police, February 25-28, 1971.

67. Deterrent effects of strong penalties seem to be negligible even if they are actually given. In Holland, in 1960, 47 per cent of all drivers convicted fro driving while impaired were unconditionally sentenced to jail. In 1970, this percentage had risen to 70 per cent. In Sweden, 40 per cent of convicted drivers were sentenced to prison in 1968, constituting 4,000 cases. Yet, in both countries, the incidence of driving after drinking appears to be increasing. About forty per cent of all prison sentences in Sweden are for driving after drinking. See note 24 for reference.

68. Buikhuizen, W. and Van Weringh, J. Politie, auto en veilig verkeer (Police, motor car and traffic safety).

Wolters-Noordhoff, Groningen, the Netherlands, 1969.

69. Lucas, D.M. Countermeasures against drinking drivers. Paper presented at the conference mentioned in note 9.

70. See notes 12 and 57 for references.

71. McGuire, F.L. and Kersh, R.C. An evaluation of driver education. Berkeley University of California Press, 1969.

72. This means that no more than 5% of the readings should fall outside the range .09 and 11% by wt. if the true BAC level is 10% by wt.

73. The total number of kilometres driven was divided by the total number of charges laid for driving while under the influence of alcohol. Data were obtained frm the supporting documents to this report. Miles were converted into kilometres. The number of kilometres driven per charge was thus estimated as follows:

Australia	2.2 million kms
Austria	3 million kms
Belgium	3.9 million kms
Canada	1.6 million kms
Denmark	3.2 million kms
France	5 million kms
U.K.	7.8 million kms
Hungary	5.3 million kms
Japan	1.6 million kms
Netherlands	5.5 million kms
New Zealand	5.3 million kms
Norway	2.2 million kms
Poland	0.8 million kms
South Africa	3.2 million kms

On the basis of roadside surveys, estimates can be made of the total number of kilometres driven while the driver is over the legal BAC level. These estimates are 1.67 per cent in Canada, 3 per cent in France and 2.5 per cent in the Netherlands (i.e., over .08% by wt.), but future research with roadside surveys might well reveal that they are inaccurate. If one divides these estimates of total number of kilometres driven while legally impaired, by the total number of charges laid, one may arrive at the estimates of objective apprehension risk. The numbers of 'drunk kilometres' driven per charge are:

Canada	26,000 kms
France	150,000 kms
Netherlands	136,000 kms

Estimates of the percentages of legally impaired drivers vary greatly across the time of day. At certain times they have been found to exceed 10 per

cent of all passing drivers. If the total number of kilometres driven as well as the total number of charges laid between particular hours were known, more accurate estimates of objective apprehension risk would become possible.

74. See references in notes 39 and 47.

75. The subjective chances of being caught for excess of speed limits are also considerably higher than the actual probabilities. See note 47 and Cramton, R.C. Driver behaviour and legal sanctions: A study of deterrence. Michigan Law Review, 1969, 63, 421-454.

76. The suggestion has been made that drivers after their first offence should be given special licence plates or other easily detectable markers on their cars. This would facilitate the apprehension of repeaters. However, cars are frequently used by more than one driver. The social and other possible repercussions of such a measure have not yet been worked out. A special colour driver's licence has also been proposed.

77. See note 66.

78. Malfetti, J.L. Countermeasures against drinking drivers. Paper presented at the conference mentioned in note 9.

79. Swinehart, J.W. and Grimm, A.C. (eds.). Public information programmes on alcohol and highway safety. Highway Safety Research Institute, University of Michigan, Huron Parkway and Baxter Road, Ann Arbor, Michigan.

80. Wilde, G.J.S. L'Hoste, J., Sheppart, D. and Wind, G. Road Safety Campaigns, Design and Evaluation. The use of mass communications for the modification of road-user behaviour. OECD Publications, Paris, 1971. Also available in French: Campaignes de sécurité routière, calcul et évaluation. Emploi des communications de masse pour modifier le comportement des usagers de la route. OCDE, Paris, 1971.

81. The Edmonton Study - A pilot project to measure the effectiveness of community public information programmes in changing knowledge, attitude and behaviour in relation to driving and the use of beverage alcohols. Road and Motor Vehicle Traffic Safety, Department of Transport and The Canada Safety Council. Information Canada, 1973.

82. Report on road-side surveys conducted in Alberta and New Brunswick, Road and Motor Vehicle Traffic Safety, Ministry of Transport, Ottawa, Canada. 1973.

83. "The danger of having a traffic accident increases with the amount drunk".

84. (a) Tallquist, A. Therapeutic measures and the traffic offender. Department of Psychology, Institute of Occupational Health, Helsinki, Finland, 1969.

(b) Kaestner, N., Warmoth, E.J. and Syring, E.M. Oregon study of advisory letters: The effectiveness of warning letters in driver improvement. Traffic Safety Research Review, 1967. 11, 67-72.

(c) Wilson, W.T., Lonero, L., and Brezina, E.A. Skills-improvement approach to collision reduction. Ontario Department of Transportation and Communications, Toronto, Ontario, March, 1972.

85. Same reference as in note 55.

86. See note 79.

87. If for instance, among all those who drive after drinking, the social drinkers are most affected by the countermeasure, thereby reducing their share of the fatal accidents, the proportional contribution of the very heavy drinkers must necessarily increase. An increase in the proportion of those with BAC readings over the legal limit in the total number of drivers killed may thus be observed, and this would not be incompatible with a reduction in the rate of fatal accidents.

88. See note 80.

89. Roadside Surveys of Drinking-Driving Behaviour - A Review of the Literature and a recommended Methodology. The report of a sub-committee of the OECD semi-independent group on the Effects of Alcohol and Other Drugs on Driver Behaviour. Road and Motor Vehicle Traffic Safety, Canadian Ministry of Transport, 1973.

90. A weighing procedure should be used on the basis of the traffic volume per time unit, if not all drivers participate in the survey.

91. Comparable to other unexpected events such as construction sites and accidents that already have occurred.

92. "Who really causes the accidents?" (Interview with B.J. Campbell). Traffic Safety, December, 1971, 22-24.

93. See note 31.

94. "As I have not had a drink, I am cold sober; I can drive a little faster, a little longer and take a few more chances, here and there, because I can handle it". Also, see Naisbitt, J. The great holiday massacre: A study of impact. Traffic Safety, 1961, 58, 12-15, 36, 48-49.

95. This is one mechanism that might explain the return to pre-existing trends in fatal accidents rates, some two or three years after the change-over to right-hand traffic in Sweden. The immediate effect of this measure was a reduction in fatality rate of approximately 20 per cent. It might also explain why Britain observed a reduction in BAC levels in killed drivers after the introduction of 'the .08 law', in addition to a reduction in the rate of fatal accidents. Similarly, Buikhuizen and Jongman refer to a phenomenon (see note 39) that may be called the 'New Year's Eve Effect' pertaining to a reduction in accident rates when 'everybody on the road assumes that everybody else is drunk'. Also see note 65.

96. Brown, I.D., and Copeman, A.K. Drivers' attitudes to the seriousness of road traffic offences considered in relation to the design of sanctions. Paper to be presented at first International Conference on Driver Behaviour. October 8-12, 1973 - Zurich, Switzerland.